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(54) ELECTRODE PASTE FOR SEMICONDUCTOR SUBSTRATE

(57)Abstract:

PURPOSE: To provide an electrode paste for a semiconductor substrate having an excellent adhesiveness to the semiconductor substrate and a sufficiently small contact resistance.

CONSTITUTION: A paste contains 100 pts.wt. of silver powder 0.05 to 10 pts.wt. of metallic silicide power comprising more than one kind out of titanium silicide, tantalum silicide, nickel silicide, zirconium silicide, niobium silicide, chromium silicide, molybdenum silicide, and tungsten silicide, and 15 to 40 pts.wt. of an organic vehicle.

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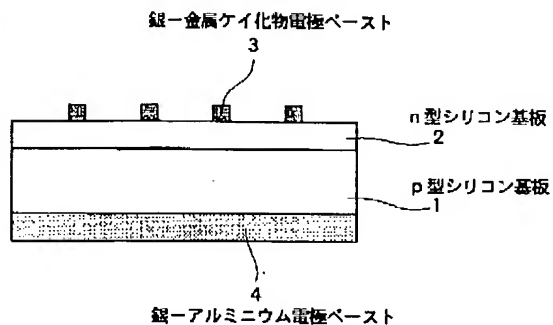
CLAIMS

[Claim(s)]

[Claim 1] Electrode paste for semi-conductor substrates characterized by having the 100 weight sections, metal silicide powder 0.05 - 10 weight sections, and the organic vehicle 15 - 40 weight sections in the end of silver dust.

[Claim 2] a metal silicide -- silicification -- titanium and silicification -- a tantalum and silicification -- nickel and silicification -- a zirconium and silicification -- niobium and silicification -- chromium and silicification -- molybdenum and silicification -- the electrode paste for semi-conductor substrates according to claim 1 characterized by consisting of one or more sorts of things among tungstens.

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Drawing selection drawing 1

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the electrode paste especially formed of screen-stencil on semi-conductor substrates, such as a solar battery, about the electrode paste formed on a semi-conductor substrate.

[0002]

[Description of the Prior Art] From a viewpoint of aiming at development of industry, a close-up of an environmental problem is taken, the demand to clean energy has become strong, maintaining harmony with nature in recent years, and the interest about a solar battery is increasing as one means of them. by the way, the base of a solar battery -- about 100 years before -- selenium ***** -- being certain -- although it was and started in the cuprous-oxide photoelectric cell, since conversion efficiency was as low as 1 - 1.5%, it did not result in utilization. After that, conversion efficiency will become about 6% 1954 by establishment of the large area pn junction production technique especially using the single crystal Si, and about 10 - 15% of thing is obtained as conversion efficiency of a current solar battery by development of semi-conductor engineering. The technical problem which is in charge of utilization of this solar battery is to reduce a manufacturing cost, aiming at improvement in the applied conversion efficiency. Therefore, also about electrode formation, since it says that the formation of automatic continuation is possible by the sex from Takao, the print processes of low cost are adopted instead of the vacuum deposition of the former [electrode / a light-receiving side electrode and / rear-face]. Properties, like that adhesion with a semi-conductor substrate is good, that contact resistance is small (carry out ohmic contact), and the resistance of electrode paste is low are demanded of the conductive paste (henceforth "electrode paste") used for the electrode formation by these print processes, and the following electrode paste is well-known. first -- JP, 54-26676, A -- "-- the electrode material which added aluminum or Ti during Ag paste -- a silicon substrate top -- printing -- this -- N2 -- the inside of an ambient atmosphere -- low-temperature baking -- carrying out -- having -- the low semiconductor device of the contact resistance of an electrode and a silicon substrate -- it is going to manufacture -- invention" about an approach and its semiconductor device is indicated (henceforth "the conventional technique I"). moreover -- JP, 59-33867, A -- "-- the silicon oxide which carries out printing baking of the electrode material which added the rare earth element during Ag paste on a silicon substrate, and is formed in a semi-conductor front face at the time of baking -- the above-mentioned rare earth element -- returning -- having -- the low electrode material of the contact resistance of an electrode and a silicon substrate -- it is going to obtain -- invention" is indicated (henceforth "the conventional technique II").

[0003] Thus, the ohmic contact to a silicon substrate and an electrode is secured as much as possible, and various kinds of proposals for aiming at improvement in conversion efficiency are made. However, if it was in the conventional technique, the bond strength between the semi-conductor substrate after baking and an electrode might not necessarily be enough, and in the solar battery used especially under a harsh environment, it might deteriorate with time that early reinforcement was high, and might result in peeling of an electrode. Moreover, although there are a semi-conductor substrate and inter-electrode contact resistance as an important element which influences the conversion efficiency of a solar battery, when a substrate and inter-electrode adhesion are not enough, conversion efficiency becomes low by the increase of contact resistance and the manifestation of rectifying contact by both poor contact. For example, the conversion efficiency of the solar battery produced by the approach concerning the conventional technique I is a maximum of 12%, and it is not enough practical, and the contact resistance is also in the range of 10-2 - 10-3 ohm-cm, and it cannot be said that it is so low. Moreover, the contact resistance of the solar battery which uses the electrode material of the conventional technique II as the electrode is in the range of 0.03 - 0.34 ohm-cm, and is still higher than the conventional technique I.

[0004] This invention is made in view of such a trouble that a Prior art has, the purpose has good adhesion with a semi-conductor substrate, and it is for contact resistance to offer the electrode paste for semi-conductor substrates small enough.

[0005]

[Means for Solving the Problem] The electrode paste for semi-conductor substrates characterized by this invention having the 100 weight sections, metal silicide powder 0.05 - 10 weight sections, and the organic vehicle 15 - 40 weight sections in the end of silver dust in order to attain the above-mentioned purpose is considered as the first invention. the first above-mentioned invention -- setting -- a metal silicide -- silicification -- titanium and silicification -- a tantalum -- silicification -- nickel and silicification -- a zirconium and silicification -- niobium and silicification -- chromium and silicification -- molybdenum and silicification -- the electrode paste for semi-conductor substrates characterized by consisting of one or more sorts of things among tungstens is considered as the second invention.

[0006] What is used for the common electrode paste ingredient can be used for an end of silver dust, and organic vehicle. For example, the particle size in the end of silver dust is 10 micrometers or less, and the configuration can use anythings, such as the shape of a globular shape and a flake. As an organic vehicle, what dissolved the resin of a cellulose system or an acrylate system in solvents, such as terpeneol, butyl carbitol, and Cellosolve, for example can be used.

[0007] Since the silicide is contained in electrode paste, the adhesion of a silicon substrate and an electrode is secured with the compatibility by this silicon and the same element in a silicon substrate, and it is not necessary to necessarily add glass powder for adhesive reservation. Glass powder can still be added to improve both adhesion more. However, since the solder wettability of electrode paste which calcinated glass powder with 10 weight ***** gets remarkably bad, as for the addition of glass powder, it is desirable to carry out to below 10 weight sections.

[0008]

[Function] At the time of paste baking, since metal silicide powder with bigger surface area than a semi-conductor substrate front face carries out the trap of the oxygen preferentially, oxidation of a semi-conductor substrate front face is controlled, and the ohmic contact to a substrate and an electrode is acquired. Moreover, since the silicide is contained in electrode paste, the adhesion of a silicon substrate and an electrode is secured with the compatibility of this silicon and the same element in a silicon substrate.

[0009] Under in the 0.05 weight section, since there are few amounts of oxygen traps at the time of baking, the contact resistance of a semi-conductor substrate and electrode paste becomes [the addition of this metal silicide to the 100 weight sections] high in the end of silver dust. On the other hand, if the addition exceeds 10 weight sections, the degree of sintering of electrode paste is checked, and while the calcinated electrode serves as porous ones and the own resistance of an electrode becomes high, contact resistance with a semi-conductor substrate will become high. Moreover, the loadings of the organic vehicle to the 100 weight sections are not easy for pasting in under 15 weight sections in the end of silver dust, and on the other hand, if the loadings exceed 40 weight sections, resistance of the electrode after baking will become high too much.

[0010]

[Example] Although the example of this invention is explained below, this invention is not limited to these examples. The metal silicide shown in the following table 1 to the 100 weight sections in the end of silver dust it consists of mean particle diameter of 0.8 micrometers was blended, and this compound was further mixed with the organic vehicle 22 weight section which dissolved the ethyl cellulose 7 weight section in solvent terpeneol. And the three aluminas roll mill was passed and such mixture was pasted. In addition, about some examples, optimum dose addition of the glass powder was carried out.

[0011] Subsequently, it applied on 2nd page of n mold silicon substrate of the silicon substrate of the pn junction which shows the silver-metal silicide electrode paste 3 which carried out in this way and was obtained to drawing 1, and on the other hand, silver-aluminum electrode paste 4 was applied on the 1st page of a p-type silicon substrate, and it was able to be burned for 5 minutes at 600 degrees C. And from the current-voltage characteristic of the solar battery which carried out in this way and was produced, it asked for "contact resistance of a silicon substrate and an electrode", and a "fill factor", and "solder wettability" and "bond strength" were investigated by the approach explained below. The result is shown in the following table 2.

[0012] the solder which consists of solder wettability =62Sn/36Pb/2Ag -- using -- under 220-degree-C quiescence bath of the solder -- the above-mentioned solar battery -- after the immersion during 10 seconds -- pulling up --

enough -- a conductor -- the case where O and a pinhole were accepted in the case where the front face has got wet in solder was made into x.

[0013] Bond strength = the wire with a diameter of 0.6mm was fixed on the electrode (2mm**) of the above-mentioned solar battery with the above-mentioned solder, and the Peel reinforcement was measured. The value is [0.5kg or more] success.

[0014]

[Table 1]

	銀粉末	金属ケイ化物	有機ビヒクル	ガラス粉末
実施例1	100	チタンシリサイド 2.0	22.0	—
" 2	"	タンタルシリサイド 2.0	"	—
" 3	"	ニッケルシリサイド 2.0	"	—
" 4	"	ジルコニウムシリサイド 2.0	"	—
" 5	"	ニオブシリサイド 2.0	"	—
" 6	"	クロムシリサイド 2.0	"	—
" 7	"	モリブデンシリサイド 2.0	"	—
" 8	"	タングステンシリサイド 2.0	"	—
" 9	"	チタンシリサイド 0.05	"	—
" 10	"	" 5.0	"	—
" 11	"	" 10.0	"	—
" 12	"	" 2.0	"	1.0
" 13	"	" 4.0	"	2.0
比較例1	100	チタンシリサイド 0.02	22.0	2.0
2	"	" 15.0	"	—

[0015]

[Table 2]

	半田濡れ性	接着強度 (k g)	接触抵抗 (Ω -cm)	フィルファクター
実施例1	○	合格 (0. 86)	0. 0027	0. 756
" 2	○	合格 (0. 75)	0. 0061	0. 727
" 3	○	合格 (1. 03)	0. 0044	0. 735
" 4	○	合格 (0. 69)	0. 0035	0. 748
" 5	○	合格 (0. 87)	0. 0010	0. 772
" 6	○	合格 (1. 14)	0. 0021	0. 741
" 7	○	合格 (0. 77)	0. 0014	0. 770
" 8	○	合格 (0. 93)	0. 0066	0. 728
" 9	○	合格 (0. 61)	0. 0049	0. 739
" 10	○	合格 (1. 24)	0. 0009	0. 776
" 11	○	合格 (1. 36)	0. 0006	0. 783
" 12	○	合格 (1. 26)	0. 0009	0. 779
" 13	○	合格 (1. 41)	0. 0017	0. 752
比較例1	○	× (0. 38)	0. 14	0. 631
2	×	測定不可	0. 29	0. 714

[0016] Since the metal silicide of optimum dose is added by the electrode material concerning this example so that clearly [Table 2], contact resistance with a silicon substrate is very low, solder wettability is good, and bond strength is high. However, since there are too few additions of a metal silicide, the example 1 of a comparison cannot control oxidation of a silicon substrate, but is high, and is low. [of bond strength] [of the contact resistance of a silicon substrate and an electrode] Moreover, since the example 2 of a comparison has too many additions of a metal silicide, whenever [sintering / of electrode paste] is inadequate and a baking side serves as porous one. Consequently, since good ohmic contact could not be acquired, contact resistance was high, solder wettability was poor and even measurement of bond strength of it was not completed.

[0017]

[Effect of the Invention] According to this invention, as explained above, the contact resistance of a substrate and an electrode can fully be low, and solder wettability is good, and electrode paste with high bond strength can be offered, and it can use very suitably as an electrode material for semi-conductor substrates.

[Translation done.]